CAPM: $r_{jt} = \alpha_j + \beta_{j1} r_{mt} + \varepsilon_{jt}$

'ama & French three-factor Model (FF)

Fama & French: $r_{jt} = \alpha_j + \beta_{j1} r_{mt} + \beta_{j2} r_{smbt} + \beta_{j3} r_{hmlt} + \varepsilon_{jt}$

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CAPM

```
. regress rj rm
      Source |       SS       df       MS              Number of obs =  11,959
-------------+------------------------------           F(1, 11957)   =5988.94
       Model |  11449.5344     1  11449.5344            Prob > F      =  0.0000
    Residual |  22859.1346 11,957 1.91177842            R-squared     =  0.3337
-------------+------------------------------           Adj R-squared =  0.3337
       Total |  34308.669  11,958 2.86909759            Root MSE      =  1.3827

------------------------------------------------------------------------------
          rj |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          rm |   .9947206   .0128536    77.39   0.000     .9695254    1.019916
       _cons |   .0084273   .0126552     0.67   0.505    -.0163789    .0332335
------------------------------------------------------------------------------
```

```
. test rm=1

 ( 1)  rm = 1

       F(  1, 11957) =    0.17
            Prob > F =    0.6813
```

FF model

```
. regress rj rm smb hml
      Source |       SS       df       MS              Number of obs =  11,959
-------------+------------------------------           F(3, 11955)   =2057.22
       Model |  11681.1999     3 3893.73328            Prob > F      =  0.0000
    Residual |  22627.4691 11,955 1.89272013            R-squared     =  0.3405
-------------+------------------------------           Adj R-squared =  0.3403
       Total |  34308.669  11,958 2.86909759            Root MSE      =  1.3758

------------------------------------------------------------------------------
          rj |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          rm |   1.005554   .0128271    78.39   0.000     .9804104    1.030697
         smb |   .0371377   .0061189     6.07   0.000     .0251437    .0491318
         hml |   .0562866     .00609     9.24   0.000     .0443492    .068224
       _cons |   .0073088   .0125928     0.58   0.562    -.0173752    .0319928
------------------------------------------------------------------------------
```

```
. test rm=1

 ( 1)  rm = 1

       F(  1, 11955) =    0.19
            Prob > F =    0.6651
```

```
. test smb hml

 ( 1)  smb = 0
 ( 2)  hml = 0

       F(  2, 11955) =   61.20
            Prob > F =    0.0000
```

1. Jensen Alpha fail to reject from both of CAPM model (pvalue 0.505 > 0.05) and FF model (p-value 0.562). Thus jensen Alpha is insignificant.

2. Testing hypothesis $H_0: \beta_1 = 1$
since portfolio J have the same risk as market risk, β has to be 1.
Conclusion, Both CAPM (pvalue 0.6813 > 0.05) and FF model (pvalue 0.6651 > 0.05) have fail to reject. it means that portfolio J has the same risk as market risk or $\beta = 1$

3. FF model show that Pvalue of size premium is rejected (Pvalue 0.00 < 0.05). there exist significant.

4. FF model show that pvalue of growth premium is rejected (Pvalue 0.00 < 0.05). there exist significant.

5. To test which one is appropiate. we will set test hypothesis of $H_0: \beta_2 = \beta_3 = 0$ to know that if $\beta_2 = \beta_3 = 0$ it means β_2 and β_3 doesnot explain the portfolio and FF model will be less significant.
conclusion, FF test is more appropriate. since P-value (0.00 < 0.05) is rejected. and β_2 and $\beta_3 \neq 0$. Thus size premium & growth premium help to explain and shouldn't be eliminated.

To study calendar effect (January effects) from the data set, estimate the following models:

$$r_{jt} = \alpha_j + \gamma_j D_{1t} + \beta_{j1} r_{mt} + \beta_{j2} r_{smbt} + \beta_{j3} r_{hmlt} + \varepsilon_{jt} \qquad (3)$$

where: $D_{1t} = 1$ on January and $= 0$ otherwise.

```
. regress rj d1 rm smb hml
      Source |       SS       df       MS              Number of obs =  11,959
-------------+------------------------------           F(4, 11954)   =1543.31  (2)
       Model |  11683.8263     4 2920.95657            Prob > F      =  0.0000
    Residual |  22624.8427 11,954 1.89265875            R-squared     =  0.3406  (3)
-------------+------------------------------           Adj R-squared =  0.3403
       Total |  34308.669  11,958 2.86909759            Root MSE      =  1.3757

------------------------------------------------------------------------------
          rj |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          d1 |     .05393  (1) .045781     1.18   0.239    -.0358082    .1436682
          rm |   1.005405      .0128275    78.38   0.000     .9802607    1.030549  (4)
         smb |   .0369291     .0061214     6.03   0.000     .0249302    .048928
         hml |   .0562495      .00609      9.24   0.000     .0443121    .0681868
       _cons |   .0028773     .0131425     0.22   0.827    -.0228842    .0286388
------------------------------------------------------------------------------
```

6. I use ANCOVA model because it conclude quantitative independent variable.
look into january effect (D1) we can see that p-value (0.239 > 0.05) is insignificant because there are fail to reject from t-test, individual test.

7. To Interpret, from rm = 1.005 it means that return on market portfolio = 1.005. and overall test, F test is significance since p-value (0.00 < 0.05). there are enough variable to explain portfolio J. and 4 variable can explain around 34.06 % of return on market portfolio from value of R^2. Moreover, there only 2 variables (size premium and growth premium) which significance to explain rm. (pvalue of both = 0.00 < 0.05). But January effect doesn't exist significant in this data set because p-value 0.239 > 0.05 and fail to reject.

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8.

```
reg rj rm smb hml
```

Source	SS	df	MS	Number of obs	=	11,959
				F(3, 11955)	=	2057.22
Model	11681.1999	3	3893.73328	Prob > F	=	0.0000
Residual	22627.4691	11,955	1.89272013	R-squared	=	0.3405
				Adj R-squared	=	0.3403
Total	34308.669	11,958	2.86909759	Root MSE	=	1.3758

rj	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
rm	1.005554	.0128271	78.39	0.000	.9804104	1.030697
smb	.0371377	.0061189	6.07	0.000	.0251437	.0491318
hml	.0562866	.00609	9.24	0.000	.0443492	.068224
_cons	.0073088	.0125928	0.58	0.562	-.0173752	.0319928

```
sca rss1=e(rss)

sca n1=e(N)
reg rj rm smb hml if d1==0
```

Source	SS	df	MS	Number of obs	=	10,974
				F(3, 10970)	=	1887.21
Model	10805.6192	3	3601.87308	Prob > F	=	0.0000
Residual	20936.975	10,970	1.90856654	R-squared	=	0.3404
				Adj R-squared	=	0.3402
Total	31742.5942	10,973	2.89279087	Root MSE	=	1.3815

rj	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
rm	1.008159	.0134224	75.11	0.000	.9818484	1.034469
smb	.0364768	.0064347	5.67	0.000	.0238636	.04909
hml	.0553364	.0063956	8.65	0.000	.0427998	.0678729
_cons	.0027652	.0131985	0.21	0.834	-.0231062	.0286367

```
sca rss2=e(rss)

sca n2=e(N)
reg rj rm smb hml if d1==1
```

Source	SS	df	MS	Number of obs	=	985
				F(3, 981)	=	169.11
Model	872.032797	3	290.677599	Prob > F	=	0.0000
Residual	1686.17832	981	1.71883621	R-squared	=	0.3409
				Adj R-squared	=	0.3389
Total	2558.21111	984	2.59980804	Root MSE	=	1.311

rj	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
rm	.9725647	.0435176	22.35	0.000	.8871664	1.057963
smb	.0402395	.0198549	2.03	0.043	.0012766	.0792024
hml	.0659675	.0199538	3.31	0.001	.0268104	.1051246
_cons	.0580564	.0421181	1.38	0.168	-.0245956	.1407084

```
sca rss3=e(rss)

sca n3=e(N)
```

```
g hmld1=hml*d1

reg rj rm smb hml d1 rmd1 smbd1 hmld1
```

Source	SS	df	MS	Number of obs	=	11,959
				F(7, 11951)	=	881.86
Model	11685.5157	7	1669.35938	Prob > F	=	0.0000
Residual	22623.1533	11,951	1.89299249	R-squared	=	0.3406
				Adj R-squared	=	0.3402
Total	34308.669	11,958	2.86909759	Root MSE	=	1.3759

rj	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
rm	1.008159	.0133675	75.42	0.000	.9819563	1.034361
smb	.0364768	.0064084	5.69	0.000	.0239153	.0490383
hml	.0553364	.0063695	8.69	0.000	.0428511	.0678216
d1	.0552912	.0461135	1.20	0.231	-.0350988	.1456811
rmd1	-.035594	.0475853	-0.75	0.454	-.1288689	.0576808
smbd1	.0037628	.0217997	0.17	0.863	-.0389682	.0464937
hmld1	.0106311	.0218876	0.49	0.627	-.0322721	.0535344
_cons	.0027652	.0131445	0.21	0.833	-.0230002	.0285307

```
test d1 smbd1 hmld1 rmd1

 ( 1)  d1 = 0
 ( 2)  smbd1 = 0
 ( 3)  hmld1 = 0
 ( 4)  rmd1 = 0

       F(  4, 11951) =    0.57
            Prob > F =    0.6844
```

From CHOWtest & FFtest, they are fail to reject January effect (H_0: $d_1 = smbd_1 = hmld_1 = rmd_1 = 0$), Then there is no structure changes ($0.6844 > 0.05$)